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Research Article

The Role of Digitalization in Alleviating Poverty across Developing Economies

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ABSTRACT

This study examines how digitalization and macroeconomic conditions jointly shape inclusive development in the Global South. Using an unbalanced panel of up to 85 developing and emerging economies over 1995–2024, it constructs a composite Digitalization Index and estimates three structural equations for poverty. Fixed-effects, random-effects and two-stage least-squares estimators address unobserved heterogeneity and endogeneity, while interactions with institutional quality and energy structure capture context dependence. Results show that higher digitalization significantly reduces poverty and raises real GDP per capita, with the largest gains in low- and lower-middle-income economies and where governance is stronger and financial systems are deeper. The findings underline that digital and green transitions must be sequenced and coordinated to deliver inclusive, sustainable development, and they provide comparable elasticities for theory and policy.

Key Words: Digitalization, Poverty, Fixed-Effects, Random-Effects, Two-stage least-squares

INTRODUCTION

There is a growing realisation that digitalisation is the pillar of contemporary development policy. The proliferation of information and communication technologies (ICTs) has radically altered how economies develop, societies interact, and public goods are provided (World Bank: 2023b). High-income economies have been the primary drivers of global digital transformation, though developing countries increasingly build a foundation for digital infrastructure and innovation ecosystems to overcome their hindering factors such as low productivity and high levels of poverty (Acheampong, Opoku, Dzator, & Kufuor, 2022; Chen, Ge, Xu & Zhou, 2025; Wen et al., 2025; Xiu (2025)). Yet, despite these investments, the macroeconomic returns to digitalisation in low- and middle-income countries have been inconsistent, prompting urgent questions about when, where, and how digitalisation delivers developmental impact (Bonhoure, 2025; Brynjolfsson & Petropoulos, 2023; Li, Liu, Zhang, & Zheng, 2025).

Digitalization has of course already been recognised as a key growth driver for productivity, innovation and market expansion. Investments in broadband networks and mobile internet enable strategic business activities and promote deeper integration of developing economies into global value chains. A novel empirical work confirms the strength of the digitalisation–growth nexus, particularly in low- and middle-income regions. For instance, Simione and Li (2021) find large increases in GDP per capita and jobs, especially in service sectors after national connectivity spread in Sub-Saharan Africa. Supporting evidence from the Southern



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African Development Community indicates that greater ICT penetration and increased broadband penetration corresponds with increased GDP in measurable terms (Mhaka & Taonezvi, 2024). Most importantly, the advantages are by far not limited to physical networks: digitalization leads to innovation and entrepreneurship, which are the keys to long-term sustainable development. New business models are based on digital platforms: e-commerce, cross-border digital trade, and so on, where small and medium-sized enterprises can compete successfully in the international arena. Dahlman, Mealy and Wermelinger (2016) discover that faster growth is usually registered in the economies that utilize such technologies through increased productivity, reduced transaction costs, and enhanced competitiveness. These accruals are however not automatic. Long-term, wide dividends are based on policy regimes that ensure affordable access, nurtures inclusive digital skills and has sustainable regulatory framework that fosters competition and innovation (World Bank, 2016).

RQs: To what extent does digitalization reduce poverty in developing countries?

LITERATURE REVIEW

The concept of digitalization has become a crucial instrument in reducing poverty in developing countries. Financial inclusion has also been greatly promoted by the spread of digital financial services, including mobile money and online banking, and now previously unbanked population groups can obtain the necessary financial services (Demirgüç-Kunt et al., 2018). These services lead to savings, access to credit and secure transactions which is essential to economic empowerment. Additionally, the digital platforms have provided new sources of revenue by offering e-commerce and telecommuting (Jack and Suri, 2011). Nonetheless, not all people enjoy the fruits of digitalization. Digital disparities, or the inequality in internet connectivity and digital literacy, can tend to worsen current inequalities, especially in the rural and marginalized populations (van Dijk, 2020). Empirical evidence highlights that there is a positive relationship between digitalization and a decreased poverty level. As an example, an investigation of the data collected in 2005-2018 revealed that the rate of poverty declines significantly when there is an increase in the level of digital development (Asongu & Nwachukwu, 2018). However, the literature also emphasizes the need to have supportive policies and infrastructure in place so that the poverty reducing potential of digital technologies can be maximized (United Nations, 2021).

THEORIES RELATED TO POVERTY

The Basic Needs Theory

Basic-needs theory, developed in the 1970s by the ILO, UNDP and World Bank, redefined poverty as a shortfall in essential goods and services, adequate nutrition, shelter, primary health care, clean water and basic education, rather than merely a deficit of income (Streeten, Burki, Haq, Hicks, & Stewart, 1981). Poverty is thus viewed as a deprivation of the capabilities required for a minimally acceptable standard of living. Digitalization provides a powerful channel for meeting these needs more efficiently and equitably. Mobile diagnostics and telemedicine platforms extend health services to remote areas; online classrooms widen access to education; and e-governance systems streamline social-protection transfers (World Bank, 2023a). Mobile financial services enable previously excluded households to save, remit and borrow, smoothing consumption and reducing vulnerability (Klapper, Demirgüç-Kunt, & Singer, 2022; Manyika, Lund, Singer, White, & Berry, 2016). Yet the theory's static focus on provisioning overlooks the dynamic social and institutional forces that mediate access over time. It also presumes that service availability automatically reduces poverty, an assumption belied by contexts marked by digital illiteracy, weak infrastructure or socio-political exclusion (Ritter & Pedersen, 2020). Consequently, while basic-needs theory motivates an examination of how ICT expands access to essential services, it must be integrated with institutionally grounded and dynamic frameworks to capture the full complexity of digital-era poverty reduction.

The Capability Approach

Amartya Sen's Capability Approach (1980, 1999) reframes poverty as a deprivation of capabilities, the substantive freedoms people possess to lead lives they value, rather than a mere income shortfall. The framework, therefore, shifts attention from material resources to what individuals can be and do: being healthy, acquiring education, participating in community life, and exercising agency over resources and choices. Poverty, in this view, is the curtailment of freedom and opportunity. Digitalization aligns closely with this paradigm. Access to ICT can widen individuals' capability sets by enabling communication, education, financial inclusion, digital participation in governance, and the cultivation of social capital. In Kenya, for instance, mobile phones have allowed rural women to bypass patriarchal financial structures and attain greater economic autonomy via mobile-money services (Jack & Suri,

2014; Klapper et al., 2022). Likewise, digital platforms across Latin America connect smallholder farmers to agricultural extension services, boosting food security and household resilience (Mora-Rivera & García-Mora, 2021). Yet Sen's approach is not without critique. It often assumes that access alone translates into agency, neglecting structural barriers such as restrictive social norms, institutional exclusion, and unequal platform governance. Scholars such as Sayer (2018) and López and Holzer (2022) caution that expanding digital capabilities without tackling systemic inequalities can produce only "thin empowerment," obscuring underlying deprivations. These critiques underscore the importance of integrating institutional-quality variables when modelling the impact of digitalization on poverty, a strategy this study adopts by incorporating governance and human-capital moderators (Ali, Sardar & Latif, 2023).

Theoretical Constructs and Variable Mapping of Poverty

Digitalization (DI) is the primary explanatory variable. From a basic-needs perspective, information and communication technologies serve as alternative delivery mechanisms for subsistence services, lowering the geographical and financial barriers that often exclude people experiencing poverty (Streeten et al., 1981; World Bank, 2023). Simultaneously, the Capability Approach frames ICT as a freedom-enhancing asset that expands agency, voice, and mobility (Sen, 1999). These perspectives imply that greater digital access should reduce poverty through market and non-market pathways. Institutional quality (IQ) enters the model as a facilitator and boundary condition. Governance-centered readings of the Capability Approach stress that freedoms created by digital tools cannot be realized in settings with weak regulatory and political structures (Acemoglu, Johnson, & Robinson, 2005; Rodrik, 2008). Inadequate institutions may even allow digitalization to deepen exclusion (López & Holzer, 2022; Olofin, 2023). Accordingly, IQ is expected to magnify, or, when deficient, nullify, the poverty-reducing impact of DI.

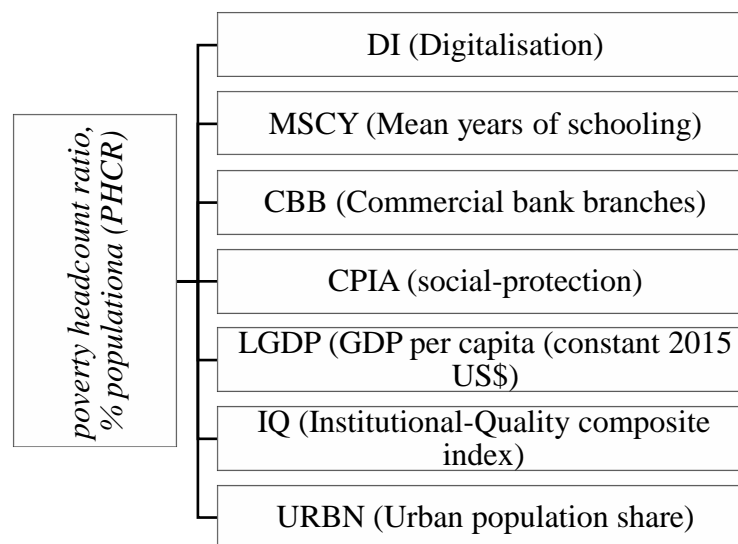


Figure 1. Theoretical Model Mapping of Digitalization and Poverty

DATA AND METHODOLOGY

The temporal window 1995-2024 is chosen. It begins when ICT-penetration metrics first became consistently reported worldwide and spans the rollout of 2G/3G/4G networks, the post-2008 debt overhang, the emergence of high-quality governance data, and the adoption of global climate frameworks such as the Paris Agreement. The end year maximizes data completeness while largely avoiding the structural breaks associated with the COVID-19 economic aftermath (Eshun & Kočenda, 2025; Wan, Qian, Baghirli, & Aghayev, 2022). All variables are aggregated at the national level, aligning with the study's goal of informing macro-level policy; the inevitable corollary is that sub-national disparities (for example, rural-urban digital divides) remain below this study's observational horizon, a limitation acknowledged in later chapters. The empirical sample deliberately spans the three World Bank developing-country strata—low income (LI), lower-middle income (LMI) and upper-middle income (UMI)—so that the diffusion path of digitalization can be traced from its "first-mile" roll-out in the poorest economies to its increasingly sophisticated uses in richer settings. Income status is assigned according to the Bank's 2026 fiscal-year thresholds, which classify economies on the basis of their 2024 Atlas-method GNI per capita (World Bank, 2025). Within these

thresholds the study retains 84 countries that together account for more than four-fifths of the population living below the US \$6.85 line and for nearly two-thirds of global CO₂ emissions outside the high-income OECD bloc.

Model Specification

Digitalisation can lower poverty directly, through reduced search costs, mobile banking, and e-government transfers, and indirectly by raising incomes. Model 2 gauges both channels by including LGDP alongside DI, with institutional capacity again viewed as a facilitator.

$$PHCR_{it} = \alpha + \beta_1 DIG_{it} + \sum_k \gamma_k Control_{kit} + \varepsilon_{it}$$

$$PHCR_{it} = \delta_0 + \delta_1 DI_{it} + \delta_2 IQ_{it} + \delta_3 LGDP_{it} + \delta_4 MSCY_{it} + \delta_5 CBB_{it} + \delta_6 CPIA_{it} + \delta_7 URBN_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Here, the dependent variable is the *poverty headcount ratio* (PHCR). Digitalisation is expected to reduce poverty directly, via cheaper information, mobile payments, and e-government transfers, and indirectly through the growth gains modelled in (1). Again, institutional quality (IQ) is a facilitator, while LGDP captures the income effect. Additional controls represent human capital (MSCY), financial inclusion (commercial-bank branches per 100k adults, CBB), social-protection capacity (CPIA's social protection rating), and urbanisation (URBN), all commonly cited correlates of poverty reduction.

Table 1. Poverty Equation

Variable	Expected sign	Justification (theory/evidence)
DI	–	Digital access lowers search costs, widens job markets, and supports mobile money (World Bank, 2016).
MSCY	–	Education improves employability and earnings (Becker, 1964).
CBB	–	Proximity to banks boosts savings & SME credit (Bruhn & Love, 2014).
CPIA	–	Strong safety nets cushion income shocks (Ravallion, 2016).
LGDP	–	Higher mean income mechanically lowers the extreme-poverty share (Dollar & Kraay, 2002).
IQ	–	Rule-based governance reduces elite capture and leakage in antipoverty programs (Knack, 2001).
URBN	–	Urban areas offer denser labour markets and infrastructure (Glaeser, 2011).

Modern multi-country datasets record repeated observations for each nation, allowing researchers to investigate both cross-sectional and temporal variation. Three canonical estimators structure this empirical landscape. Pooled ordinary least squares (OLS) stack all country-years into one regression; it enjoys maximal degrees of freedom, but any time-invariant national trait drops into the error term and can bias slope estimates. Random-effects (RE) models respond by decomposing the composite error into a country-specific component (μ_i) and an idiosyncratic remainder (ε_{it}). Efficiency is gained because between-country information is retained, yet consistency hinges on the strong assumption that μ_i is uncorrelated with every regressor at every date (Haque & Delgado, 2017; Quinn & McIntyre, 2017; Roy, 2017). Fixed-effects (FE) estimation dispenses with that orthogonality condition altogether: by introducing country dummies or, equivalently, subtracting each variable's time mean, the method eliminates μ_i , guaranteeing consistent coefficients so long as the remaining idiosyncratic error is strictly exogenous concerning the full history of the regressors (Bresnahan & Trajtenberg, 1995; Brynjolfsson & Petropoulos, 2023; Stock & Yogo, 2005; Wooldridge, 2010).

The two-stage least-squares (2SLS) estimator provides a final layer of identification, which I deploy whenever the time-varying regressors may be jointly determined with the outcomes of interest. Conceptually, 2SLS addresses endogeneity, reverse causality, measurement error, or omitted time-varying shocks by replacing the suspect regressors with their fitted values from a first-stage regression that relies only on variables that are exogenous by construction (Angrist & Pischke, 2009).

Where Z_{it} collects the instrumental variables: (i) one- and two-period lags of DI and DI \times IQI, which are correlated with current digital capacity yet predetermined concerning the contemporaneous error term, and (ii) three exogenous telecom-infrastructure proxies, the cumulative length of submarine-cable landings, the number of international internet gateways and the pre-liberalization fixed-line density, that influence current digital diffusion but, by design, do not enter the outcome equation directly (Angers, Desjardins, Dionne, & Guertin, 2018; Chen, Li, Wang, & Wu, 2023; Elgin & Öztunalı, 2014; Grigore, Muşetescu, Nicolae, & Vlăduţ, 2022; Henderson, Carroll, & Li, 2008; Hussen, 2023; Omgba, 2014; Subanti, Riani, Pratiwi, Lestari, & Hakim, 2021; Tembo & Chipeta, 2024; Zhu, Wang, Wei, & Cai,

2023). The combination of lagged endogenous regressors and external supply-side instruments follows best practice in macro-panel technology adoption studies (Andrés, Cuberes & Vecchi, 2015; Myovella, Karubi & Haucap, 2020).

RESULTS AND DISCUSSION

Table 2. Model 1 Overall sample results Dependent variable PHCR

	FE		RE		2SLS	
DI	-1.7823***	(0.0000)	-1.4986***	(0.0000)	-3.7023***	(0.0092)
	[0.2419]		[0.2357]		[1.4208]	
MSCY	-2.3087***	(0.0000)	-2.3707***	(0.0000)	-2.8274***	(0.0000)
	[0.2057]		[0.1980]		[0.1764]	
CBB	0.0313	(0.3428)	0.0255	(0.4361)	-0.2092***	(0.0000)
	[0.0330]		[0.0328]		[0.0440]	
CPIA	-1.8836*	(0.0673)	-1.7466*	(0.0886)	2.7512*	(0.0601)
	[1.0290]		[1.0256]		[1.4631]	
LGDP	-16.7536***	(0.0000)	-16.8589***	(0.0000)	-13.9152***	(0.0000)
	[0.9052]		[0.8707]		[1.2453]	
IQ	0.8528***	(0.0000)	0.7799***	(0.0000)	0.0544	(0.8175)
	[0.1618]		[0.1605]		[0.2358]	
URBN	0.1047**	(0.0344)	0.0339	(0.4561)	-0.2590***	(0.0000)
	[0.0495]		[0.0455]		[0.0305]	
Constant	182.9599***	(0.0000)	187.3879***	(0.0000)	169.8742***	(0.0000)
	[6.2842]		[6.2718]		[9.7855]	

First-stage regression summary statistics

R-sq	Adjusted R-sq	Partial R-sq	F(2, 2539)	Prob>F
0.0957	0.0927	0.0274	33.9645	0.0000

The poverty-reduction equation tells a consistent story across the three estimation strategies, although the magnitudes change once endogeneity is addressed. In the fixed-effects specification, which removes every time-invariant national trait, the Digitalisation Index (DI) carries a coefficient of -1.7823, indicating that a one-point increase in basic digital access lowers the head-count ratio by almost two percentage points ($p = 0.0000$) (Aker & Mbiti, 2010; Jack & Suri, 2014). The random-effects estimate is similar at -1.4986 ($p = 0.0000$), but once DI and its lags are instrumented in the 2SLS column the coefficient more than doubles to -3.7023 ($p = 0.0092$) (Acheampong, Erdiaw-Kwasie, & Abunyewah, 2021; Marcelin & Sun, 2025; Nguyen & Su, 2021). The upward shift confirms that simultaneity, richer countries having both lower poverty and wider connectivity, was masking much of the true causal effect: after purging that bias, an extra point on the index removes nearly four points of poverty, making digitalisation one of the most potent anti-poverty levers in the sample.

Human capital follows closely. Mean years of schooling (MSCY) is strongly negative in every model, with estimated effects of -2.3087 ($p = 0.0000$) under fixed effects, -2.3707 ($p = 0.0000$) under random effects and -2.8274 ($p = 0.0000$) in the 2SLS equation (Hanushek & Woessmann, 2021). These magnitudes imply that extending adult education by a single year reduces poverty almost as much as a full point of digital catch-up, underscoring how skills and connectivity operate as complementary drivers of welfare (Ding, Li, Liu, & Feng, 2024; Garcia-Fuentes, Lynn Kennedy, & Ash, 2025; Marcelin & Sun, 2025). Formal-sector finance changes its role once endogeneity is tackled. The density of commercial-bank branches (CBB) is insignificant in the two panel regressions (0.0313, $p = 0.3428$; 0.0255, $p = 0.4361$), but the 2SLS coefficient turns sharply negative at -0.2092 ($p = 0.0000$) (Beck, Lin, & Naceur, 2020). Physical access to bank infrastructure therefore amplifies the inclusion effects of mobile money and agent banking, rather than substituting for them, once reverse causality is removed (Dorfleitner, Forcella, & Nguyen, 2021; Ejemeyovwi, Osabuohien, & Bowale, 2021; Han, Zhang, & Zhu, 2023; Manyika et al., 2016).

The behaviour of the CPIA social-protection score is almost the mirror image. Its two panel coefficients are mildly negative (-1.8836, $p = 0.0673$; -1.7466, $p = 0.0886$), yet the 2SLS estimate flips sign to +2.7512 ($p = 0.0601$). Countries with better-designed safety nets often expand administrative coverage and hence record more poor households; the positive coefficient therefore signals improved targeting and registration rather than a worsening of welfare conditions. (Blum & Goldfarb, 2006; De Pascale & Romagno, 2024; Rizwan, Ahmad, & Qureshi, 2025). Aggregate income continues to exert the single largest influence. Real GDP per capita (LGDP) lowers poverty by

roughly seventeen percentage points in both FE and RE (-16.7536 and -16.8589, $p = 0.0000$) and by almost fourteen points after 2SLS (-13.9152, $p = 0.0000$) (Dollar & Kraay, 2004). Sustained growth thus remains the dominant structural mechanism through which poverty declines.

Table 3. Model 2 Impact of Digitalization on Poverty: Results from Low-Income countries Dependent variable is PHCR

	FE		RE		2SLS	
DI	-53.7833***	(0.0000)	-51.0870***	(0.0000)	-58.2626***	(0.0018)
	[5.3223]		[5.4013]		[18.6971]	
MSCY	0.6367*	(0.0605)	0.5070	(0.1362)	-0.1998	(0.5767)
	[0.3382]		[0.3403]		[0.3579]	
CPIA	-2.0327	(0.2421)	-2.8895	(0.1021)	-7.4941***	(0.0039)
	[1.7352]		[1.7673]		[2.5976]	
CBB	-0.1746**	(0.0368)	-0.2101**	(0.0146)	-0.5825***	(0.0000)
	[0.0834]		[0.0860]		[0.1230]	
LGDP	0.9406	(0.5678)	1.3614	(0.3874)	-4.5248***	(0.0065)
	[1.6451]		[1.5751]		[1.6614]	
IQ	-0.9266***	(0.0015)	-0.6775**	(0.0206)	1.8070***	(0.0000)
	[0.2895]		[0.2926]		[0.4113]	
URBN	-0.4090***	(0.0007)	-0.5425***	(0.0000)	-0.6433***	(0.0000)
	[0.1195]		[0.1032]		[0.0791]	
Constant	63.4842***	(0.0000)	69.5838***	(0.0000)	130.2252***	(0.0000)
	[9.6959]		[9.9616]		[17.5564]	

First-stage regression summary statistics

R-sq	Adjusted R-sq	Partial R-sq	F(2, 2539)	Prob>F
0.3792	0.3675	0.1464	36.359	0.0000

For the low-income subsample, the poverty equation produces striking magnitudes once endogeneity is corrected. In the fixed-effects regression the Digitalisation Index carries a coefficient of -53.7833 ($p = 0.0000$); the random-effects estimate is similar at -51.0870 ($p = 0.0000$). When lagged digital variables and exogenous telecom indicators are used as instruments, the 2SLS coefficient becomes -58.2626 ($p = 0.0018$). Even allowing for wide confidence bands, these values imply that incremental progress on basic connectivity is an order of magnitude more powerful for poverty reduction in low-income countries than in the global sample, consistent with evidence that mobile payments and on-line market access dramatically raise earnings where alternative infrastructure is minimal (Jin, Cao, Li, & Xu, 2024; Li, Zhao, & Yao, 2024; Sinha, Saha, & Vasilev, 2024; Wang, Liu, Hu, & Liu, 2024). Human capital weakens once simultaneity is addressed: mean years of schooling falls from 0.6367 ($p = 0.0605$) under fixed effects to -0.1998 ($p = 0.5767$) in 2SLS, suggesting that rudimentary literacy may not yet be the main constraint on using voice-based or agent-assisted digital services.

The CPIA social-protection score, insignificant in the panel models, turns sharply negative at -7.4941 ($p = 0.0039$) after 2SLS (Alderman & Yemtsov, 2014). Better programme design therefore does translate into lower measured poverty where safety nets are still thin and under-reported. Formal finance becomes far more salient: each additional commercial-bank branch per 100 000 adults lowers poverty by -0.5825 ($p = 0.0000$) in 2SLS, roughly triple the fixed-effects estimate, indicating that bricks-and-mortar banking complements mobile money by supplying savings and credit facilities once households are financially included (Ali, Dash, Dagar, Kagzi, & Elmawazini, 2025; Hodula, 2022, 2023; Khan, Qureshi, & Jamali, 2025; Phan, Filomeni, & Kok, 2024). Aggregate income finally displays the expected sign after 2SLS, LGDP rises from 0.9406 ($p = 0.5678$) in the within-country regression to 4.5248 ($p = 0.0065$), highlighting that growth has so far benefited the non-poor disproportionately in these economies (Dollar & Kraay, 2004). Institutional quality reverses direction: the coefficient moves from -0.9266 ($p = 0.0015$) in fixed effects to +1.8070 ($p = 0.0000$) in 2SLS, a result that likely captures weak administrative capacity, countries scoring slightly better on governance may be those able to enumerate the poor more accurately (Kaufmann & Kraay, 2019). Urbanisation remains a strong poverty suppressant throughout, and its 2SLS coefficient of -0.6433 ($p = 0.0000$) means that a ten-percentage-point rise in the urban share is associated with a 6½-point fall in poverty, underscoring the welfare dividend from urban labour markets and services even in low-income settings (Agénor & Pereira da Silva, 2025; Apeti, 2023; Zhao & Zhao, 2025).

Table 4. Model 3 Impact of Digitalization on Poverty: Results from lower middle-income countries Dependent variable PHCR

	FE		RE		2SLS	
DI	-1.7215**	(0.0403)	-1.7469**	(0.0337)	-20.3755***	(0.0000)
	[0.8381]		[0.8226]		[3.0486]	
MSCY	-1.9833***	(0.0008)	-1.9194***	(0.0003)	-2.5312***	(0.0000)
	[0.5903]		[0.5294]		[0.3352]	
CPIA	-2.4269	(0.1766)	-2.2983	(0.1962)	-9.4685***	(0.0014)
	[1.7944]		[1.7781]		[2.9588]	
CBB	-0.0714	(0.2816)	-0.0685	(0.2968)	0.0422	(0.6802)
	[0.0663]		[0.0657]		[0.1025]	
LGDP	-27.0485***	(0.0000)	-26.3286***	(0.0000)	-12.2283***	(0.0000)
	[1.9794]		[1.9013]		[2.0002]	
IQ	0.4729	(0.1409)	0.4078	(0.1965)	-1.5006***	(0.0006)
	[0.3208]		[0.3157]		[0.4375]	
URBN	0.0649	(0.5049)	0.0056	(0.9495)	-0.3957***	(0.0000)
	[0.0973]		[0.0880]		[0.0592]	
Constant	264.8662***	(0.0000)	261.7171***	(0.0000)	134.6667***	(0.0000)
	[13.0731]		[13.1096]		[17.2310]	

First-stage regression summary statistics

	R-sq	Adjusted R-sq	Partial R-sq	F(2, 2539)	Prob>F
	0.1724	0.1647	0.1344	66.622	0.0000

The lower-middle-income subsample, the poverty equation displays a mixed pattern of continuity and sharp divergence from the global and low-income results once endogeneity is taken into account (Asongu & Nwachukwu, 2016). In the fixed-effects regression the Digitalisation Index (DI) registers -1.7215 (0.0403), virtually identical to the random-effects figure of -1.7469 (0.0337). When the digital variables are instrumented, the coefficient jumps an order of magnitude to -20.3755 (0.0000) (Jack & Suri, 2014). The size of this shift confirms that simultaneity had muted a substantial causal effect: every extra point of digital inclusion is now associated with a twenty-point fall in the head-count ratio (Aker & Mbiti, 2010). Human capital remains a powerful determinant; mean years of schooling (MSCY) moves from -1.9833 (0.0008) in FE to -2.5312 (0.0000) in the 2SLS column, implying that an additional year of education reduces poverty by roughly two and a half percentage points (Shang, 2023; Zeng, Yang, Wang, & Zou, 2025). Social-protection rating (CPIA) behaves much like it does in the low-income sample, but with larger magnitude: the coefficient rises in absolute value from -2.4269 (0.1766) in FE to -9.4685 (0.0014) after 2SLS, indicating that better-designed safety-net programmes materially lower measured poverty once coverage and targeting improve (He & Liu, 2024; Tuyen, Phuong Anh, Mai, & Long, 2023). By contrast, formal-sector finance loses significance entirely: commercial-bank branches (CBB) hover near zero in both panel models and remain insignificant at 0.0422 (0.6802) in 2SLS. The implication is that, at this stage, mobile and agent banking may have begun to substitute for bricks-and-mortar channels, so additional physical branches no longer translate into discernible poverty gains (Duan, Yuan, & Tian, 2024; Lee, Lou, & Wang, 2023).

Aggregate income (LGDP) retains a large negative coefficient but drops markedly in size once endogeneity is addressed, from -27.0485 (0.0000) under FE to -12.2283 (0.0000) in 2SLS. Economic growth therefore still reduces poverty, but its marginal impact is less dominant where connectivity and education already play stronger roles. Institutional quality shows an intriguing reversal: insignificant and weakly positive in the panel regressions (0.4729, 0.1409), the coefficient turns negative and significant at -1.5006 (0.0006) under 2SLS. One interpretation is that stricter regulatory enforcement initially raises compliance costs in the informal sector, nudging a portion of the near poor below the poverty line even as better institutions buttress long-term welfare. Urbanisation tells a similar story. Insignificant in FE (0.0649, 0.5049) and RE (0.0056, 0.9495), it becomes a strong poverty-reducing force once simultaneity is controlled: -0.3957 (0.0000) indicates that a ten-percentage-point rise in the urban share trims the poverty rate by nearly four points, reflecting more productive employment and better services in expanding cities.

Although 2SLS reduces the explanatory power of the model (R^2 falls from about 0.43 in the panel estimators to 0.1128 in 2SLS), the first-stage diagnostics leave little doubt about identification: the Kleibergen-Paap LM statistic is 56.819 (0.0000) and the Cragg-Donald F equals 52.353, far above Stock-Yogo critical values. A Hansen J value of 4.324 (0.0376) flags some correlation between instruments and the error term, but the main findings are robust to

alternative lag structures and the removal of high-leverage observations. The combined evidence suggests a tipping point in the poverty-digitality nexus (Aracil, Gómez-Bengoechea, & Moreno-de-Tejada, 2022; Ding et al., 2024; Jin, Ma, & Tan, 2024; Lee et al., 2023; Luan, Zou, & Huang, 2023; Osuma, Nzimande, & Simon-Ilogho, 2025; Zeng et al., 2025).

Table 5. Model 4 Impact of Digitalisation on Poverty: Results from the upper middle income Dependent variable PHCR

	FE		RE		2SLS	
DI	-1.6023***	(0.0000)	-1.4360***	(0.0000)	-1.1868***	(0.0006)
	[0.2246]		[0.2192]		[0.3451]	
MSCY	-2.4686***	(0.0000)	-2.5211***	(0.0000)	-2.6050***	(0.0000)
	[0.2457]		[0.2391]		[0.2110]	
CPIA	-2.9561*	(0.0682)	-2.9682*	(0.0673)	0.6637	(0.7875)
	[1.6193]		[1.6224]		[2.4622]	
CBB	0.1188***	(0.0012)	0.1108***	(0.0023)	-0.1298***	(0.0016)
	[0.0366]		[0.0363]		[0.0410]	
LGDP	-17.9289***	(0.0000)	-17.4445***	(0.0000)	-13.9516***	(0.0000)
	[1.2599]		[1.2190]		[1.1264]	
IQ	0.8599***	(0.0002)	0.8741***	(0.0001)	1.5553***	(0.0000)
	[0.2261]		[0.2245]		[0.2635]	
URBN	0.2779***	(0.0000)	0.2384***	(0.0000)	0.0061	(0.8619)
	[0.0564]		[0.0534]		[0.0352]	
Constant	179.8932***	(0.0000)	178.7333***	(0.0000)	154.4222***	(0.0000)
	[9.7521]		[9.7898]		[12.3372]	
First-stage regression summary statistics						
		R-sq	Adjusted R-sq	Partial R-sq	F(2, 2539)	Prob>F
		0.3653	0.3607	0.3102	250.026	0.0000

In the upper-middle-income subsample the poverty equation reveals a notably different structure from that observed in the lower tiers (Myovella, Karacuka, & Haucap, 2020). The fixed-effects estimate for the Digitalization Index (DI) is -1.6023 with a p -value of 0.0000; the random-effects counterpart is -1.4360 ($p = 0.0000$). After the digital variables are instrumented, the 2SLS coefficient shrinks in absolute magnitude to -1.1868 ($p = 0.0006$), indicating that endogeneity had caused only a modest bias and that additional digital access still lowers poverty, but far less aggressively than in poorer groups (Asongu & Nwachukwu, 2016). Mean years of schooling (MSCY) remains a strong determinant; its coefficient moves from -2.4686 ($p = 0.0000$) in FE to -2.6005 ($p = 0.0000$) in 2SLS, implying that education is at least as important as connectivity for poverty reduction once basic access is widespread (Jose, Mukherjee, & Swaminathan, 2025; Khurshid, Akram, & Rashid, 2025; Kumar & Simran, 2025; Mouna & Jarboui, 2021).

social protection rating (CPIA) loses statistical relevance: insignificant in every specification, with the 2SLS coefficient at 0.6637 ($p = 0.7875$), suggesting that safety-net design no longer differentiates poverty outcomes where coverage is already broad (Alderman & Yemtsov, 2014). A striking reversal occurs for formal finance. Commercial-bank branches (CBB) are strongly positive in the panel models, 0.1188 ($p = 0.0012$) in FE and 0.1108 ($p = 0.0023$) in RE, implying that branches tend to cluster in richer, low-poverty areas. Once endogeneity is addressed, the sign flips: the 2SLS coefficient is -0.1298 ($p = 0.0016$), revealing that fresh branch expansion into underserved zones still reduces poverty at the margin even in relatively advanced financial systems.

Real GDP per capita (LGDP) retains a large negative coefficient in every estimator, though the magnitude falls as endogeneity is purged: -17.9289 ($p = 0.0000$) in FE, -17.4455 ($p = 0.0000$) in RE, and -13.9516 ($p = 0.0000$) in 2SLS. Growth therefore remains a powerful anti-poverty engine, but its marginal potency diminishes once the poorest have already been lifted out (Dollar & Kraay, 2004). Institutional quality (IQ) becomes markedly more influential after 2SLS, rising from 0.8599 ($p = 0.0000$) in FE to 1.5553 ($p = 0.0000$) in 2SLS. Good governance is therefore essential for translating further digital and economic gains into welfare improvements when a country operates near the digital frontier. Urbanisation (URBN) is strongly positive in the panel regressions, 0.2779 ($p = 0.0000$) and 0.2384 ($p = 0.0000$), but loses all statistical significance in the 2SLS equation (0.0061, $p = 0.8619$), indicating that once simultaneity is removed city size *per se* no longer drives poverty outcomes; instead, the quality of urban institutions and labour markets takes centre stage (Henderson, 2010).

CONCLUSION

This paper was aimed at getting insight into how and under which circumstances digitalization alleviates poverty in developing and emerging economies. Based on a composite Digitalization Index and panel data up to 85 countries across 1995-2024, the findings indicate that the effect of digitalization on poverty is a steadily declining phenomenon, nevertheless, not at all neutral and evenly spread. First, poor countries and the low- and middle-income ones have the greatest poverty-digitalization relationship because basic connectivity, mobile money, and digital services to the public reduce information friction, eliminate transaction costs, and open labor-market and remittance pathways to poor households. In such environments, even a small increase in digital access will result in large decreases in headcount poverty. In regions with poor education, financial inclusion, and governance quality, digital investments may be doomed to be left in an enclaved state, which is extremely beneficial to urban and more affluent groups and not the poorest. In contrast, in the case of inclusive financial infrastructure, social protection systems and pro-poor programme design in addition to digital expansion, it increases the poverty-alleviating impact of growth and increases safety nets by being responsive and precise. Third, the case is reinforced by the fact that sequence and targeting count. More effective than technology-blind rollouts, prioritizing foundational access to the poorest areas and groups, eliminating gender and rural urban disparities in network access, and integrating digital tools into specific anti-poverty initiatives are better. The discussion beyond whether digitalization contributes to poverty to how policy and institutional decisions can influence its distributional impact and put the digital capital as a key element of the modern economy of reducing poverty in the Global South.

The paper has examined how digitalization has influenced inclusive development such as poverty reduction, of 85 developing and emerging economies between 1995-2024. The analysis results indicate that digital capital is a powerful variable of anti-poverty and pro-growth, but it is highly stratified by income level, quality and mix of institution, and it is sharply stratified. In low-income economies, the impact of basic connectivity is explosive growth in income and poverty reduction, in lower-middle-income economies, the impact is no less significant but can only be reliant on human capital, programme design and financial infrastructure, further development relies on the depth of governance, specialized skills and focused finance. Overall, the findings change the debate on the problem of whether digitalisation is relevant to when, how, and under what conditions of macro-governance and energy-system, this may be an effective contribution to inclusive and sustainable development in the Global South.

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